

WHAT IS CLAIMED IS:

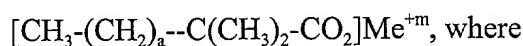
1. A method for manufacturing a high-temperature fuel cell, comprising:

manufacturing a cathode;

applying at least one electrolyte and anode; and

thermally treating a whole construction of the high-temperature fuel cell, whereinafter manufacturing the cathode, a step of applying an interface layer, a current passage, the electrolyte, the anode and an electrical insulating layer is performed using the same apparatus, and wherein

a metal-organic complex used to manufacture high-temperature fuel cell components to be applied, interfaced, and caked is prepared having the common formula:



n is from 1 to 7,

m is a metal valence, and

Me is a material selected from the group consisting of Mg, Ca, Sr, Ba, Al, Sc, Y, In, La and lanthanides, Ti, Zr, Hf, Gr, Mn, Fe, Co, Ni, Cu, and the oxides of said metals for forming the cathode, the anode, the current passage, the electrolyte, the interface and electrical insulating layers.

2. The method according to Claim 1 wherein, in the step of manufacturing the cathode, metal-organic complexes are used as the binding material while mixing the cathode mass to be formed.

3. The method according to Claim 1, wherein in the step of a metal-organic complex is used to manufacture all high-temperature fuel cell components, said metal-organic complex is used as the liquid phase of organic carriers for thin-disperse solid phases of corresponding powder materials in order to manufacture the current passages, the electrolytes, the interface and electrical insulating layers.

4. The method according to Claim 1, wherein the metal-organic complex is used in a liquid phase to prepare a mixture-paste, said mixture-paste including rough and thin

dispersions of ion- and electron-conductive corresponding powder materials to manufacture a cermet of the anode.

5. The method according to Claim 1, wherein in the step of a metal-organic complex is used to manufacture all high-temperature fuel cell components, said metal-organic complex is used directly as the liquid phase.

6. A method for manufacturing a carrier ceramic cathode of a high-temperature fuel cell, comprising:

jointly precipitating carbonates from a solution of lanthanum nitrate and manganese nitrate, thereby synthesizing a powder of an electrode material comprising a doped lanthanum manganite;

preparing a formable mass by isostatic compacting of a composition comprising said powder and an organic binding component, wherein said binding component comprises at least one carboxylate of a chemical element selected from the group consisting of La, Mn, Ni, Cr and Co, said chemical element being doped with an alkaline-earth element; and

heating said formable mass to form a carrier substrate at a temperature not higher than 1380°C.

7. The method according to Claim 6, wherein, the heating said formable mass is performed at a temperature not higher than 1380°C in order to achieve the caking without shrinkage of cathodes, wherein said cathodes are made from the powder of the electrode material described by the formula  $\text{La}_x\text{A}_{1-x}\text{MnO}_3$  where A is either Mg, or Ca, or Sr, or Ba or their mixture  $0.6 < x < 1.0$ .

8. The method according to Claim 6, wherein, acids with a common formula  $\text{C}_n\text{H}_{2n+1}\text{O}_2$  where n is  $\text{C}_6$  to  $\text{C}_{12}$ , are used to prepare the organic binding component comprising said at least one carboxylate.

9. The method according to Claim 6, wherein the sum concentration of metals in the composition of the carboxylates is from 20 to 360 g per kg.

10. The method according to Claim 6, wherein the mass of the organic binding components is 3 to 15% relative to the formable mass.

11. The method according to Claim 7, wherein the powder of the electrode material is mixed with the organic binding component containing the Mn, La or Co, La, or Cr, La, or Ni, La, doped by elements from the group of alkaline-earth elements, wherein the binding component generates, after its decomposition, compounds selected from the group consisting of:  $\text{LaSr}_{1-7}\text{MnO}_3$ , or  $\text{LaSr}_{1-y}\text{CoO}_3$ , or  $\text{LaSr}_{1-7}\text{CrO}_3$ , or  $\text{LaSr}_{1-y}\text{NiO}$ , where  $0.6 < y < 1.0$ .

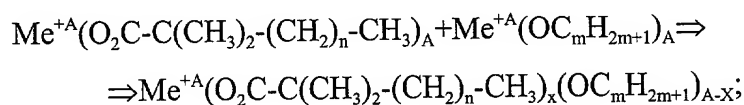
12. A method for manufacturing a solid oxide electrolyte of the high-temperature fuel cell, comprising:

preparing an initial metal-organic compound;

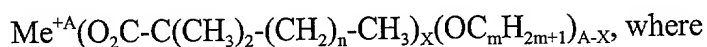
heating a ceramic electrode up to a predetermined temperature;

applying the prepared metal-organic compound onto the surface of the electrode; and

thermally treating the electrode with the formed electrolyte, wherein the metal-organic compound for manufacturing the solid oxide electrolyte is synthesized using the reaction:



forming a mixture, wherein components of said mixture are selected from the group consisting of metal carboxylates and metal alcoholates, having the common formula:



Me is a metal included in the functional component of the high-temperature fuel cell;

A is the valence of the given element (metal);

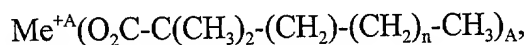
X is a coefficient determined from the following inequality:  $0 < X < A$ ;

n is from 1 to 7; and

m is from 2 to 8.

13. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein the mixing of the initial components in the step of preparing the metal-organic compound is performed at the temperature of  $80^\circ$  to  $100^\circ \text{C}$ .

14. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein the step of synthesizing the metal carboxylates having the common formula:



is performed by extraction of corresponding metals ( $\text{Me}^{+A}$ ) from water solutions comprising materials selected from the group consisting of salts of the corresponding metals and suspensions of the corresponding metals in mineral acids.

15. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein the step of synthesizing the zirconium alcoholate  $\text{Zr}(\text{OCmH}_{2m+1})_4$  is performed during the interaction of the zirconium mineral salt with the alcohol and the metallic calcium during boiling.

16. The method for manufacturing the solid oxide electrolyte according to Claim 15, wherein the metal-organic compound comprising zirconium is modified by at least one element selected from the group consisting of Mg, Ca, Sc, Y, Ce and lanthanides, and wherein said metal-organic compound is applied onto the surface of a carrier cathode by a method selected from the group consisting of rolling, painting, and spraying a gas-liquid emulsion, while scanning the means applying the prepared composition along the cathode surface at a temperature of the heated cathode of 400 to 550°C.

17. The method for manufacturing the solid oxide electrolyte according to Claim 16, wherein the step of applying the metal-organic compound onto the heated surface of the ceramic cathode is performed with the growth rate of film thickness of 10 to 25  $\mu\text{m}$  per hour.

18. The method for manufacturing the solid oxide electrolyte according to Claim 14, wherein the metal-organic compound modified by at least one element selected from the group consisting of Mg, Ca, Sc, Y, and lanthanides, is applied onto the electrode surface heated up to the temperature not higher than 550°C.

19. The method for manufacturing the solid oxide electrolyte according Claim 15, on the surface of zirconium dioxide, wherein the metal-organic compound comprising zirconium is applied onto the electrode surface heated up to the temperature of 300° to 400°C.

20. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein in order to increase the rate of applying the electrolyte film, a powder of the

modified zirconium dioxide is added to the metal-organic compound before applying said metal-organic compound to the surface of the electrode.

21. The method for manufacturing the solid oxide electrolyte according to Claim 20, wherein the powder of the modified zirconium dioxide has in its composition 95% of particles having a size less than 2  $\mu\text{m}$ , and its amount in the mixture of 0.1 to 2.0% by mass.

22. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein the step of applying the metal-organic compound onto the heated surface of the ceramic electrode is performed in the inert medium.

23. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein in order to obtain a proton electrolyte, preparing a mixture carboxylates, said mixture comprising at least one material of the chemical formula selected from the group consisting of  $\text{SrCe}_{0.85}\text{Gd}_{0.15}[\text{O}_2\text{C}-\text{C}(\text{CH}_3)_2-(\text{CH}_2)_n-\text{CH}_3]_6$  and  $\text{BaCe}_{0.85}\text{Gd}_{0.15}(\text{O}_2\text{C}-\text{C}(\text{CH}_3)_2-(\text{CH}_2)_n-\text{CH}_3)_6$ , where n is 2 to 3, and said mixture is applied onto the electrode surface heated up to the temperature not higher than 470°, wherein forming a film of the proton electrolyte of the chemical formula selected from the group consisting of  $\text{SrCeO}_{0.85}\text{Gd}_{0.15}\text{O}_3$  and  $\text{BaCeO}_{0.85}\text{Gd}_{0.15}\text{O}_3$ .

24. The method for manufacturing the solid oxide electrolyte according to Claim 12, wherein, after applying the prepared metal-organic compound onto the heated surface of the electrode, the obtained half-element is subjected to the thermal treatment at the temperature not higher than 1250°C.

25. A method for manufacturing a current passage of a high-temperature fuel cell, comprising:

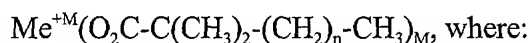
synthesizing a powder of an electron-conductive material comprising doped lanthanum chromite;

producing an ultra-disperse mixture from the synthesized powder in organic carriers; and

applying the powder on the carrier cathode with thermal treatment, wherein the thin dispersion is produced by grinding the synthesized powder of the electron-conductive material of the doped lanthanum chromite until the ultra-disperse condition in the liquid medium of the mixture of metal-organic complexes of chrome,

lanthanum and doping elements, and wherein the current passage film is manufactured by multiple steps of applying the thin dispersion onto the surface of the carrier cathode heated up to the temperature of forming, from the mixture of metal-organic complexes of chrome, lanthanum and doping elements, a gas-dense film of the doped lanthanum chromite of the composition similar to the thin-disperse powder synthesized individually.

26. The method according to Claim 25, wherein in order to manufacture the carrier of the thin dispersion of powders of doped lanthanum chromite, the carboxylates of chrome, lanthanum and doping elements are synthesized comprising the formula:



Me is a metal selected from the group consisting of Cr, La, Sr, Ca, and Mg;

M is a metal valence; and

n is from 1 to 7.

27. The method according to Claim 25, wherein a ratio between solid and liquid phases in the prepared thin dispersion is from 1/100 to 15/100 mass.

28. The method according to Claim 25, wherein the concentration of Cr, La, Sr, Mg, Ca in the mixture of liquid carboxylates is from 20 to 110 g per kg.

29. The method according to Claim 25, wherein the step of applying the current passage is performed by painting at the atmospheric pressure in the air medium.

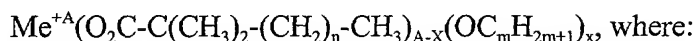
30. The method according to Claim 25, wherein the step of applying the current passage is performed by spraying a prepared mixture of carboxylates in the inert medium.

31. The method according to Claim 25, wherein the rate of thickness growth of the gas-dense film of the current passage on the surface of the carrier porous cathode is no less than 60  $\mu\text{m}$  per hour.

32. The method according to Claim 25, wherein the temperature of forming the current passage from the doped lanthanum chromite on the surface of the carrier cathode does not exceed 600°C.

33. A method for manufacturing an interface layer, comprising:  
synthesizing a metal-organic complex;

applying the metal-organic complex onto a heated substrate, said metal-organic complex comprising the formula:



Me is a metal selected from the group consisting of Cr, Mn, Co, Ni, Cu, Y, Zr, La and lanthanides, Mg, Ca, Sr, and Ba;

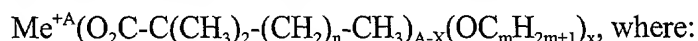
A is the valence of the given chemical element (metal);

X is a coefficient determined from the following inequality:  $0 < X < A$ :

n is from 1 to 7; and

m is from 2 to 8.

34. The method according to Claim 33, wherein in order to manufacture a gas-dense film of the interface layer, a mixture of compounds is used comprising the formula:



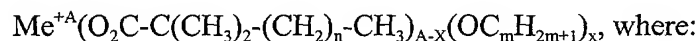
X is equal to 0; and

Me is a metal selected from the group consisting of Mg, Ca, Sr, Ba, Ce, Pr, Sm, G, and Er.

35. The method according to Claim 33, wherein a total content of metals in a mixture of compounds is not higher than 20 g per kg.

36. The method according to Claim 33, wherein the step of applying the metal-organic complex onto a heated substrate, the substrate is heated up to a temperature not higher than 530°C in the air atmosphere, thereby forming a gas-dense film of the interface layer of no greater than 0.6 μm in thickness on the surface of the doped lanthanum chromite activating the electrode reaction.

37. The method according to Claim 33, wherein in order to manufacture the gas-dense film of anti-diffusive interface layer, a mixture of compounds is used comprising the formula:



X is equal to 0;

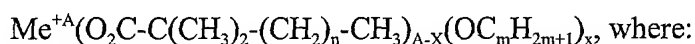
Me is a metal selected from the group consisting of Ce and doping elements Sm, Gd; and

n is from 1 to 2.

38. The method according to Claim 37, wherein the total content of metals in the mixture of compounds is not higher than 20 g per kg.

39. The method according to Claim 37, wherein the mixture is applied onto a substrate heated up to a temperature not higher than 380°C in an atmosphere of an inert gas forming a gas-dense anti-diffusive film of the interface layer of not greater than 10 μm in thickness on the surface of a doped cerium oxide.

40. The method according to Claim 33, wherein in order to manufacture the interface layer protecting a previous layer from a restorative gas medium, a mixture of compounds is used comprising the formula:



Me is a metal selected from the group consisting of Zr, Y, La and lanthanides;

A is the valence of the given chemical element (metal); and

X is an integer from 1 to A.

41. The method according to Claim 40, wherein the total content of the zirconium and doping elements in the mixture is not higher than 50 g per kg.

42. The method according to Claim 40, further comprising the step of applying the mixture is performed by painting the substrate heated up to the temperature not higher than 430°C in the atmosphere of an inert gas forming a protective interface layer of not greater than 5 μm in thickness on the surface of the doped zirconium dioxide.

43. The method according to Claim 42, wherein the atmosphere of the inert gas is selected from the group consisting of Ar, N<sub>2</sub>, and CO<sub>2</sub>.

44. A method for manufacturing cermet fuel electrodes of a high-temperature fuel cell, comprising:

forming, on the solid electrolyte in the contact with an internal air electrode, a cermet layer of the electrode consisting of a rough-disperse electron-conductive material selected from the group consisting of metallic nickel and cobalt, and rough-disperse ion-conductive material on the surface of the doped electrolyte; and

forming, on the rough-disperse layer, a separate thin-disperse electron-conductive porous multi-phased layer comprising a metallic material selected from the group consisting of the nickel and cobalt, and ion-conductive doped material

comprising cerium oxide by applying and subsequent heating a mixture-paste consisting of the thin-disperse components with a binder, wherein a cermet fuel electrode is manufactured by steps of simultaneous forming the rough- and thin-disperse components of the porous multi-phased layer, and applying the mixture-paste onto the electrolyte being in the contact with the internal air electrode.

45. The method according to Claim 44, wherein the mixture-paste is prepared by mixing the powders of the rough-disperse electron-conductive material with the rough-disperse ion-conductive material comprising electrolyte, thin-disperse ion-conductive material comprising doped cerium oxide, and liquid phase of metal carboxylates selected from the group consisting of nickel carboxylate and cobalt carboxylate, said liquid phase comprising the formula:

$\text{Me}^{+m}(\text{O}_2\text{C}-\text{C}(\text{CH}_3)_2-(\text{CH}_2)_n-\text{CH}_3)_m$ , where:

Me is selected from the group consisting of Ni and Co;

m is the metal valence;

n is from 1 to 7; and thereby

said paste during the thermal treatment form[s]ing the electron-conductive porous multi-phased layer binding to each other the rough- and thin-disperse phases forming the cermet of the fuel electrode.

46. The method according to Claim 44, wherein a ratio of solid and liquid phases in the produced paste is within the range from 1/3 to 5/7.

47. The method according to Claim 44, wherein the concentration of metal selected from the group consisting of nickel and cobalt in said liquid carboxylates is from 20 to 70 g per kg of the carboxylate.

48. The method according to Claim 44, wherein the metal powder selected from the group consisting of nickel and cobalt is added in the ratio of the metal powder to the electrolyte of 1.1/1.0.

49. The method according to Claim 44, wherein the rough-disperse particles of the metallic material selected from the group consisting of nickel powder and cobalt powder have a regular spherical structure with a diameter of 10 to 15  $\mu\text{m}$ .

50. The method according to Claim 44, wherein the synthesized rough-disperse electrolyte powder has a thread-like shape, and the ratio between the length and diameter of the particle is no less than 10:1, when the particle diameter is 5 to 10  $\mu\text{m}$ .

51. The method according to Claim 44, wherein the thin-disperse powder of the doped cerium oxide contains in this composition no less than 96% of particles having a diameter less than 2.0  $\mu\text{m}$ .

52. The method according to Claim 44, wherein the step of applying the mixture-paste is performed by painting in the air medium at room temperature and atmospheric pressure.

53. The method according to Claim 44, wherein the half-element with the applied wet mixture-paste is subjected to thermal treatment in a vacuum at a temperature not higher than 400°C and a residual pressure not greater than 0.1 atmosphere.

54. A method for manufacturing an electrical insulating layer, wherein a mixture of metal-organic complexes is used as the initial material for applying the electrical insulating layer, said mixture comprising the formula:

$\text{Me}^{\text{+A}}[(0_2\text{C}-\text{C}(\text{CH}_3)_2-(\text{CH}_2)_n-\text{CH}_3)_{1-\text{X}}(\text{OC}_m\text{H}_{2m+1})_x]_A$ , where:

n is from 1 to 7;

m is from 2 to 8;

Me is a metal selected from the group consisting of Mg, Al, Zr, Y, Ca, La and lanthanides;

A is the metal valence; and

X is from 0 to 1.

55. The method according to Claim 54, wherein the step of applying the electrical insulating layer onto the surface to be insulated is performed when heating the high-temperature fuel cell being manufactured up to a temperature not higher than 600°C.

56. The method of Claim 1, wherein the electrolyte is selected from the group consisting of doped cerium oxide and doped zirconium oxide.